DOCUMENT RESUME

ED 054 921	24	RE 003 873
AUTHOR	Waugh, Ruth	
TITLE	Modality Preference as a Function of Reading Achievement.	
INSTITUTION	Oregon Univ., Eugene. Dept. of Special Education.	
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Research.	
BUREAU NO	BR-0-I-079	
PUB DATE	Aug 71	
GRANT	OEG-X-71-0009(057)	
NOTE	50p.	
EDRS PRICE	MF-$0.65 HC-$3.29	
DESCRIPTORS	Auditory Perception; *Aural Learning; Grade 2; Individual Differences; *Learning Modalities; Memory; *Reading Achievement; *Reading Research; Teaching Methods; *Visual Learning; Visual Perception; Word Recognition	

ABSTRACT

One hundred and sixty-six second graders were administered the Illinois Test of Psycholinguistic Abilities (ITPA) and a visual and auditory memory test. Intraindividual discrepancies between a child's performance on comparable visual and auditory measures served to identify him as a visual or an auditory learner. Significantly more 5-year-old children exhibited a visual modality preference; at 7 years of age, the reverse was true. All children responded to four instructional procedures, two of which elicited simple visual and auditory recall, while the other two elicited more complex procedures in word recognition. When auditory subjects were compared to the visual subjects on performance, it was found that the former did significantly better ($p<.05$) than the latter on both visual and auditory recall tasks. No differences were noted on the more complex tasks. Longitudinal data of the ITPA were available for 39 of the subjects, and stability coefficients for a 6-months and a 26-months period were computed for each subtest. Coefficients for the 6-months period were found to be relatively stable, but for the 26-months period failed to show stability. Recommendations for instructional theories and practices are made, and suggestions for future research are given. Lists of words used in the study's instructional procedure and memory tests, score sheets, tables, and a bibliography are included. (AW)

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MODALITY PREFERENCE AS A FUNCTION OF READING ACHIEVEMENT

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U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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SUMMARY

Educators consistently recommend instruction which is tailored to meet individual differences of students. Differences which can be reliably identified, as well as procedures for adapting instruction to those differences are more frequently descriptive than empirical. One dimension of difference currently discussed is modality preference. The implication is that some children learn more readily if instructional material emphasizes the visual mode of presentation, while other children learn more easily if auditory methods are used.

Two tests were administered to one hundred sixty-six second grade children from the Eugene, Oregon public schools: the Illinois Test of Psycholinguistic Abilities, and a memory test developed at the Northwest Regional Special Educational Materials Center. Modality preference was defined as a mean score on Auditory Reception and Auditory Association which was one standard deviation above the subject's mean on the Visual Reception and Visual Association subtests. On the memory tests modality preference was defined as a score four points higher on one modality than on the other mode. Thus, intraindividual discrepancies, between a child's performance on comparable visual and auditory measures, served to identify him as a visual or an auditory learner.

Longitudinal data of the I.T.P.A. were available for 39 of these subjects. Stability coefficients for a 6 month and a 26 month period were computed for each subtest. Scores over both time periods were examined for significant subscale discrepancies.

Each of the children in the total sample responded to four instructional procedures. The first two elicited simple visual and auditory recall. Two other, more complex procedures were standardized from word recognition instruction recommended by a basal reading program.

Data on the longitudinal portion of the study led to the conclusion that the factors measured by subtests of the I.T.P.A. are relatively stable over a six month period. Coefficients were in the same magnitude as those of a well-known intelligence test. Over a two year period correlation coefficients on the I.T.P.A. were much lower than for intelligence test scores over a comparable time period.

Significantly more five year old children exhibited a preference for the visual modality than for the auditory. At seven years of age the reverse was true. It appears that exposure to the verbal world of the classroom changed modality preference.

On the aptitude treatment interaction portion of the study five percent of the subjects who exhibited greatest preference for one modality were compared with five percent showing greatest preference for the other. Disordinal interaction between the memory tests and the simple recall tasks was noted but statistical significance was not reached.

On the I.T.P.A., subjects who scored two standard deviations higher on the mean of the auditory subtests were significantly better than their visual counterparts on both visual and auditory recall tasks.

On the more complex word recognition tasks no differences were noted.

The author concludes that the results of this study are congruent with other published investigations of the interaction between perceptual preference and instructional procedures. In general, the contention that interaction does occur is based on fantasy rather than fact.

INTRODUCTION

Laymen as well as professional educators generally concede that children learn by receiving information through one of the five senses: sight, hearing, touch, taste or smell. Since the days of Galton (1883), psychologists and educators have discussed differences in modality preferences and have speculated about the possibility of relating this preference to instructional procedures. The past decade has seen development of formal organizations as well as a tremendous increase in the publication of journal articles, evaluation instruments and instructional programs designed in part to identify and capitalize upon individual modality preference.

Much of this effort has come from persons interested in the education of exceptional children. A division for Children with Learning Disability has been created within the Council for Exceptional Children. These children are defined as having normal mental ability, sensory processes, and emotional stability; but as being deficient in perceptual, integrative or expressive processes which severely impair learning efficiency. (Barsch, 1967) The first International Conference of the Association for Children with Learning Disabilities was held in 1964. Many articles dealing directly with the problem of definition have appeared in the Journal of Learning Disabilities, sponsored by the A.C.L.D. (Pannbacker, 1968; Adams, 1969; Stock, 1969; Blom & Jones 1970) although there are differences in the definitions proposed, these authors seem to agree that their common concern is for children who are normal in mental ability, sensory acuity, and emotional stability but who receive and process sensory data in some idiosyncratic manner. The deficits noted are thought to interfere with acquisition of the academic skills of reading and math when usual methods of instruction are employed.

To define the nature of modality functioning and to identify deficits more precisely a number of tests and evaluation instruments have emerged. These include Illinois Test of Psycholinguistic Abilities, Peabody Differential Learning Test, Purdue Perceptual Motor Survey, Inventory of Basic Learning Abilities, Marianne Frostig Developmental Test of Visual Perception, Developmental Test of Visual-Motor Integration, Auditory Discrimination Test, and several others.

Many of these new evaluation instruments include as part of the total package an instructional program designed to remediate the deficits identified. Other programs designed to improve modality functioning are not tied to a specific evaluation instrument. All of these programs are based on the premise that acquisition of academic skills can be accelerated by providing instruction directed toward basic psychological processes.

Given this information it might be possible to dismiss the modality issue as applying to a small segment of the total school population. However, in 1966 the Review of Educational Research published its first chapter on learning disorders (Bateman, 1966). Three task forces were commissioned by units of the U.S. Office of Education, National Society for Crippled Children & Adults,

U.S. Office of Education, National Society for Crippled Children & Adults, and U.S. Public Health Service to study the status and needs of children with learning disabilities, (Clements, 1966; Bateman and Schiefelbusch, 1969) Members of the committee appointed by the Department of Health, Education and Welfare to consider dyslexia and related reading disorders include professionals from many disciplines (Templeton, 1969). The general interest is indicated by the fact that the concern for adapting instructional programs to the individual modality preference of the child has permeated general curriculum materials. An examination of Coordinating Reading Instruction (Robinson, 1971) reveals sixteen entries related to auditory functioning, thirteen describing the visile child and twenty-three additional modality entries. This small book describes the rationale for the new Scott Foresman basal reading programs, whose Dick and Jane books have dominated reading materials for all children for the past thirty years.

Reasons for this effort are myriad. Attempts at scientific validation of folklore provide some of the momentum. In casual conversation it is not uncommon to hear people describe their own preferred modality. One person may contend that he has to see the material himself before it makes sense, while his companion extolls the value of discussion groups. Presumably the first person is a visual learner and the second learns better auditorially. Evaluation instruments and complementary instructional programs have been devised to explore the essential qualities of the preference and to capitalize upon it in the teaching act.

Certainly some of the impetus comes from societal demands that all children become literate adults. Pressure from ethnic groups, as well as middle class parents has led to demands for accountability, or demonstrated excellence in education, In an effort to improve education, psychologist and educators have re-examined all aspects of learning from basic perceptual processes to classroom interaction.

The modality issue has its roots in laboratory studies of perception. A common set of terms is used by perceptual psychologists and classroom teachers: discrimination, differentiation, visual, auditory, tactile, kinesthetic, association. Transfer of stimuli from one modality to another, sometimes called intersensory facilitation, is receiving increased attention from laboratory psychologists (Jensen, 1971). The practical application may be found in recommendations for multisensory instruction.

Children who have deviant scores on the tests previously named are often described as children with perceptual deficits. Classes, or special supplementary programs, for children with "perceptual problems" are formed after children are screened with one or more of these tests. Although there is a broad area of common interest between research psychologists and curriculum planners it is unfortunate that educators have come to use the term perception with broad loose connotations at a time when precision is indicated.

Published research reports attempting to verify assumptions underlying these tests and programs fail to support an interaction between instructional method and modality preference. Clearly, additional information is needed before educators can proceed with confidence in the purchase and use of tests and materials designed to accelerate academic performance through adaptation of the instructional program to the modality preference of the child. Some of this necessary information will come from laboratory psychologists seeking to describe the precise nature of visual and auditory perception, and intra-modal transfer. Some will come from examination of the general problems inherent in any aptitude-treatment interaction research. Cronbach and Snow (1969) and Bracht (1969) have made major contributions in this area. Their conclusions will be considered in detail in later sections of this report.

Examination of these laboratory and general problems must be supplemented by research on specific tests and instructional procedures. This research was concerned with practical problems, one step removed from actual classroom instruction. Two factors which may contribute to the negative results cited were investigated. It may be that children cannot be reliably separated on the basis of relative auditory or visual modality strength. Reliability data for some of the modality instruments is not published. In some instances small samples of children available to the investigator were re-tested without information about the representative nature of the sample. Although other instruments were carefully standardized, information about stability over time is generally not available. This information has direct application to curriculum planning. Given a relatively stable factor, programs of a year or longer might be advocated. If the factors measured are less stable, short term programs of a few months might be preferable. This research examined the stability of selected subtests of the I.T.P.A. over a 6 month and a 26 month period.

Performance of children after four instructional procedures provided the second major focus of this study. Children whose test scores indicated a preferred modality would be expected to learn more readily if instruction emphasized that modality. Conversely, learning might be more difficult if instruction emphasized a less efficient mode. Subjects were classified as auditory or visual learners on two separate modality measures and each subject's performance on two visual tasks was compared with his performance on two auditory tasks. Two of the tasks were designed to require relatively pure auditory or visual recall. Two tasks required a more integrative functioning of the two modalities. It may be that reading is an integrative process necessitating association of visual and auditory stimuli, rather than a process which can rely heavily on a preferred modality.

STATEMENT OF PROBLEM AND METHODOLOGY

There were two major foci to this study (1) stability of modality preference over two time periods, and (2) relationship between modality preference and performance after four instructional procedures designed to emphasize one modality or the other. This section deals with stability over time. If test-retest scores are not relatively constant, neither planning of intruction nor evaluation of programs along these dimensions would be possible. From review of the literature one may conclude that stability information for modality measures is virtually non-existant.

I. THE STABILITY OF MODALITY PREFERENCE

A. HYPOTHESES

To investigate the problems of stability of modality preference, the following questions were pursued through appropriate experimental procedures.

1. Do elementary school age children exhibit stable superiority in one modality as opposed to the other over two time intervals, a six month and a twenty-six month period?

   a. What is the reliability coefficient of the various subtests of the Illinois Test of Psycholinguistic Abilities over designated time intervals.

   b. What changes can be observed in classification of children at two time periods. Are more children classified as having substantial descrepancies at age five than at age seven? Stability coefficients on the standardization sample of the I.T.P.A. are higher for four year olds than for six year olds. Does this imply that children may be more dependent on one modality or the other at an early age and gradually develop a more integrative approach to learning? What is the ratio of auditory to visual learners at different ages? Research on this problem has previously been cross sectional rather than longitudinal. Results differ widely.

B. SAMPLE

A sample of ninety-eight kindergarten children was selected in Eugene, Oregon for a prior study. The I.T.P.A. was administered to these children in November, 1968 and May, 1969. Thirty-nine of these children were in attendance in the Eugene Public Schools in February, 1971. The I.T.P.A. was re-administered to these children. Hypotheses related to the stability of modality preference were examined using these data.

C. MEASURES

The following subtests of the I.T.P.A. were utilized in this portion of the study: auditory reception, visual reception, auditory association, auditory sequential memory, visual association, verbal expression, grammatic closure, and manual expression. Choice of these subtests was dictated in part by the design of a previous study. The subtests used represent two measures of each of the processes: receptive, organizing and expressive. The receptive process involves those abilities necessary to recognize and/or understand what is seen or heard. The expressive processes are those skills necessary to express ideas or to respond either vocally or by gesture or movement. The organizing processes involve internal manipulation of precepts, concepts and linguistic symbols. The subtests utilized in this study also represent both levels, the representational level, which requires a complex mediating process of utilizing symbols, and the automatic level in which the individual's habits of functioning are less voluntary but highly organized and integrated.

The Peabody Picture Vocabulary test was administered to these children. Data from this measure of intelligence have relevance to this study and are discussed in the analysis of results.

D. ANALYSIS

Pearson product moment correlations were computed for each subtest from the standard scores achieved by the thirty-nine children who were in attendance in the Eugene Public Schools for the two year period. These data were analyzed by considering the magnitude and rank order of the correlations over the 6 month and the 26 month period. Comparisons were made with the magnitude of correlations reported from longitudinal studies of intelligence tests by Honzik et al (1938) and Anderson (1940). Comparisons were also made with stability of WISC subtest over time as reported by Coleman (1963).

Any educational or psychological test scores are useful to the extent that they relate to the problems of the individual or group tested. The I.T.P.A. is recommended by the authors as a means for delineating intraindividual strengths and weaknesses in psycholinguistic functioning. Suggestions for classifying a subject as one who has discrepancies in abilities are given but the point is made that clinical judgment should supersede a rigid classification system. It is suggested by the authors that the overall performance of the child be considered a point of reference from which discrepancies may be evaluated. Either the mean or the median of the subject's scaled scores is advocated. For this study children were classified as preferring the visual modality if the mean of visual reception and visual association differed by one standard deviation from the mean of the auditory reception and auditory association subtests. A more stringent classification was also used. The means of the modality measures differed by 1.66 standard deviations or $\pm$ ten scaled score points for this more stringent classification. Chi square was computed for the distribution of scores over the two time periods.

II. RELATIONSHIP BETWEEN MODALITY PREFERENCE AND INSTRUCTIONAL PROCEDURES

HYPOTHESES

The second major focus of the present study attempted to assess the major premise espoused by authors of modality tests. Children who show marked strength on tests of one modality can be expected to learn more easily when instruction is matched to that preference.

To investigate the relationship between performance under four instructional procedures and modality preference several null hypotheses were examined.

a. Children who show a preference for auditory subtests of the I.T.P.A. do not perform better on an auditorally presented recall task than they do on a visually presented task. Recall implies that the child will be able to identify words previously shown to him and select them from words not previously used.

b. Children who show a preference for the visual subtests of the I.T.P.A. do not perform better on a visually presented recall task than they do on an auditorally presented recall task.

c. Children who show a preference for auditory subtests of the I.T.P.A. do not perform better on a word recognition task after instruction which stresses auditory stimulation, but integrates some visual components, than after instruction which stresses visual stimulation but has some auditory components.

d. Children who show a preference for visual subtests of the I.T.P.A. do not perform better on a word recognition task after instruction which stress visual stimulation but integrates some auditory components than after instruction which stresses auditory stimulation but has some visual components.

Hypotheses a, b, c, & d were repeated with a sample of children selected by the memory tests. Tests of perceptual functioning have frequently been shown to have low correlations. (See Culbertson, 1966; and Dykstra, 1968 in review of literature.) Earlier research with the memory measure resulted in interaction between modality preference and performance of children on an auditory and visual recall task. It was felt that selecting a sample of children with the memory test might result in useful comparison between the two measures of modality preference, as well as providing additional information about the main foci of these hypotheses.

B. SAMPLE

All of the second grade children (N=166) in five public elementary schools in Eugene, Oregon, including members of the first sample, were included in the portion of the study related to interaction between modality preference and performance on learning tasks. These schools were selected because they were schools with relatively low average academic achievement and were recipients of supplementary federal and state funds. These subjects could not be described as culturally deprived in the sense that inner city children are so labeled. Mean IQ on the Peabody Picture Vocabulary Test for this sample was 101.97, with a standard deviation of 15.02.

C. MEASURES

1. Tests

a. Illinois Test of Psycholinguistic Abilities
The four subtests of the I.T.P.A. thought to be most relevant to this investigation were used to examine the problems of classifying children as having substantial discrepancies in the visual and auditory modality. The subtests, with the author's descriptions, are:
(1) "Auditory Reception. This is a test to assess the ability of a child to derive meaning from verbally presented material."
(2) "Visual Reception. This test is comparable to the Auditory Reception test but utilizes a different modality. It is a measure of the child's ability to gain meaning from visual symbols."

(3) "Auditory Association. This test taps the child's ability to relate concepts presented orally. In this test the requirements of the auditory receptive process and the vocal expressive process are minimal, while the organizing process of manipulating linguistic symbols in a meaningful way is tested by verbal analogies of increasing difficulty."

(4) "Visual Association. The organizing process in this channel is tapped by a picture association test with which to assess the child's ability to relate concepts presented visually."

Examiner's Manual, Illinois Test of Psycholinguistic Abilities, 1968.

These subtests then, represent attempts to measure the child's ability to receive and to process information by the two sensory modes being investigated.

b. Test of visual and auditory memory

Two tests were developed which were designed to measure auditory and visual memory in children. It was the aim of the authors to make the tests as highly related to the reading process as possible, and thus it was decided to measure memory for words. At the beginning of a testing session, each subject was presented a series of words using nouns from Coleman's (1970) list of most readily learned words. Twenty-five nouns which had been found to be most easily recognized by young children were printed in manuscript on white index cards. The cards had been cut to three and one half by two inches to facilitate handling. Fifteen words were identified which were in the immediate sight vocabulary of the child, which means that in each case he replied correctly without hesitation upon being shown the word. These words were then used in administering the tests of visual and auditory memory. For the visual memory (VM) tests, the cards were shuffled and the top two cards were placed on the table in front of the child for a period of ten seconds. The cards were then removed and the child was asked to say the words to the examiner <u>in the order in which they were presented</u>. If the child responded incorrectly on the first trial, a series of two other cards was presented. If the correct response was given, a three card series was presented. This procedure was continued until the child missed both trials at two consecutive levels of difficulty, at which time the test was terminated. A correct response was defined as reproduction of all words presented, in the proper sequence. In scoring, four points were given for a correct response on the first presentation of each series, and two points for a correct response on the second presentation of a series of that length.

The auditory memory (AM) test utilized the same procedures as presented above, with the exception that the words were presented auditorially to the child rather than visually. In other words, the examiner would say a series of words to the child, and ask him to repeat them back in the proper sequence. For each subject, the same list of words was used for both the auditory and the visual memory test.

2. Delineation of teaching procedure

Words for all four instructional procedures were selected from the Teacher's Word Book of 30,000 Words (Thorndike & Lorge, 1944). Each group consisted of 10 words from those appearing in the second thousand. These are recommended for instruction for third grade students. Selection of words was by stratified sampling (every twelfth word). Words of this difficulty would not have been introduced as part of the regular reading program. Presentation of each pair of instructional procedures were counterbalanced among the classrooms. The visual portion was presented in five classrooms first. The auditory portion was presented first to the other five.

a. Visual recall

The words were placed on slides which were projected by means of a Bell & Howell automatic carousel projector to all members of the classes in which the subjects were regularly enrolled. Ten words were flashed on the screen for a 1 second interval with a 1 second anticipation time between words. The words were presented three times with presentation 2, and 3 using the same ten words in different order. The examiner said, "I'm going to show you some words today and then see how many you can remember. We will look at these words three times. They will be mixed up but they will all be there. Try to remember what the words are." After each series of ten the projector was stopped and the children were told, "Ready! Look at the words again. This time they are in different order."

At the conclusion of the presentation twenty words were presented. Ten were from the instructional procedure and ten were not on any of the other lists. The children were told, "Some other words have been added. See if you can remember the words we have been seeing. If the word is one we have seen mark 'yes'. If the word is not one we have seen mark 'no'." See appendix 1 for word lists and record forms. A five second interval between each presentation was allowed for marking the response. Record forms were distributed to each child prior to the instructional procedure. They were placed face down and the children were instructed to leave them in that position.

For the word recognition tasks providing integrated instruction words were placed on overhead projector transparencies. They were projected during the teacher narrative, which follows:

b. Auditory-visual word recognition
   (1) This word is _____. (teacher pronounces) (visual-auditory)
   (2) Say it with me. (auditory)
   (3) There are _____ sound parts to this word. See if you can hear them while I say the word. (teacher pronounces word by syllables) (auditory)
   (4) Say it with me in parts. (auditory)
   (5) Watch while I show you the sound parts while I say them. (teacher covers transparency with hands, exposing syllables in sequence) (visual-auditory)
   (6) Now say the parts while I show them to you. (visual-auditory)
   (7) Say it softly. (auditory)
   (8) What is this word? (auditory-visual)

This procedure utilized four instructional statements classed as auditory and four which are auditory-visual. At the conclusion of the instructional unit measurement of recognition was determined by having the child circle the correct word from four alternatives. This procedure is frequently used by the makers of workbook materials as a measure of word recognition.

c. Visual-auditory word recognition
   (1) This word is _____. (teacher pronounces word) (visual-auditory)
   (2) Teacher describes configuration (for example, it is a long word with tall letters at both ends). (visual)
   (3) Cover your eyes and see if you can remember the shape of the word. (visual)
   (4) Uncover your eyes and compare the shape you saw with the one on the card. (visual)
   (5) Say the word with me while you look at it. (visual-auditory)
   (6) Teacher describes configuration while outlining word. Example: Watch while I draw a line to show how the tall letters and short letter and letters below the line are spaced. (visual)
   (7) Let's say the word together. (visual-auditory)
   (8) Now you look at the word and tell me what it is. (visual-auditory)

Participants at the Second Conference on Verbal Learning and Verbal Behavior (Cofer and Musgrave, 1963) discussed various levels of recognition and recall. They concluded that knowledge of list membership with a yes-no response developed at a more rapid rate than recall requiring correct response on a multiple-choice item. Conference participants cited studies (Duse, 1959; Murdock, 1960) in which correct list membership occurred without correct recall. Cofer and Musgrave gave the name recognition to the simple task of identifying a word as being part of a known list; that is, list-membership. They use the term recall to describe production of a word without cues. Reading teachers use these words differently. Recognition is implied if the child can circle the correct word from a list of alternatives, a multiple choice task. Recall is considered by reading teachers to be a simpler process. The words recall and recognition are given diametrically opposite meanings by the two groups. Both groups would agree that a yes-no response is probably simpler than a multiple choice response. This research uses the terms recall and recognition as they are used by reading teachers. From this discussion it seems reasonable to conclude that tasks I and II are factorially less complex than tasks III and IV. Using Bracht's conclusions, one might expect interaction on tasks I and II without significant interaction on tasks III and IV. Thus this research was designed to clarify the stability of modality preference over two time intervals and to relate modality preference to performance under four instructional procedures. Instructional procedures I and II were constructed to involve simple variables - visual and auditory recall. Instructional procedures III and IV were constructed to require more complex word recognition. Procedures I and II were constructed to be dependent on one modality while excluding the other. Procedures III and IV were constructed to follow word recognition instructional procedures recommended by a basal reading program, and, therefore, to resemble classroom instruction, while maintaining strict control of the external conditions of learning.

D. ANALYSIS

Subjects were grouped according to modality preference derived from their I.T.P.A. test scores. Two criteria were used. One more stringent than the other. Subjects who have a marked preference for one sense mode over the other would be expected to show a difference in their learning performance when instruction emphasizes one modality. The most stringent classification identified approximately five percent of the total sample in each modality category. A less stringent classification identified approximately ten percent of the total sample as auditory learners and ten percent as visual learners. Scores on the auditory and visual recall tasks for each of the four groups were examined by means of a one tailed t-test for matched pairs. Scores on the auditory and visual word recognition tasks for these same groups were examined in the same manner. It should be noted that each child serves as his own control on the four tasks. The means from each sub-group were used in the computation of the t measures.

Subjects were regrouped on the basis of their scores on the memory tests. Two classifications of modality preference were used for these comparisons. Performance on the four tasks was compared by means of one-tailed t tests.

Ad hoc comparisons between the performance of the visual groups and the auditory groups were made. One-tailed t tests were used for these comparisons.

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DATA ANALYSIS AND DISCUSSION

Hypothesis 1a. Stability of the I.T.P.A. over two time periods

One portion of this study investigated the stability of modality preference as measured by selected subtests of the Illinois Test of Psycholinguistic Abilities over a six month and a twenty-six month period.

ANALYSIS

Pearson product moment correlations were computed for a sample of thirty-nine children who were in attendance in the Eugene Public Schools for the two year period. These data are presented in Table 3, along with stability data from Paraskevopoulos and Kirk (1969)

Stability coefficients from standardization data are given in the leftmost two columns. In the extreme left column are the test-retest data for a five month period for a sample of subjects whose Binet scores were $\pm$ 1 standard deviation from the mean. In the second column from the left the scores have been corrected, by statistical extrapolation, for the restricted intelligence range. In the second column from the right are test-retest reliability coefficients for this study for a 6 month interval. The rightmost column contains subtest correlations over a 26 month interval.

Comparisons may be made between coefficients reported in each of these four columns. Comparisons can also be made for intelligence tests cited in Table 1 and 2.

The statistically corrected reliability coefficients for the I.T.P.A. are similar in magnitude to those reported by Wechsler for the subtests of the Wechsler intelligence scale for children. They are generally in the range of .60 to 80. indicating a high relationship. Median for the I.T.P.A. subtests is .67., for the Wechsler scales, Md=.65 . Both of these columns of tables are somewhat inflated. Split-half reliability coefficients are effected by the internal consistency of the test and can be expected to be higher than test retest coefficients. Statistical extrapolation used with the I.T.P.A. is open to question. However, it is possible to conclude from these data that both tests are generally reliable measures of the factors assessed, and that reliability coefficients are roughly comparable for the two tests.

From examination of columns I, II and III of Table 3 it is evident that correlation coefficients for the 6 month interval for this study occupy an intermediate position between those reported by the test authors for the restricted and corrected range. Variability in sample influences the size of the correlation coefficient, with the restricted sample yielding a lower coefficient. This is evident from the three groups of scores. Restricted range =.21 to.82, median .47; corrected R =.45 to 86, Mdn. = .67 ; this study R =.46 to.81, Mdn. =.54.

The Peabody Picture Vocabulary Test was administered to the subjects in this study. The obtained mean and standard deviation were: M = 103.54; s.d. = 15.46. These data would indicate that the sample was not markedly different from a "normal" population on the dimensions of intelligence measured by this test. Four scores fell outside $\pm$ 1 s.d.

From an examination of columns III and IV of Table 3 one may draw conclusions about the stability of subtests of the I.T.P.A. over time. There is a general decrease of approximately .20 points over this time interval; six month interval R =.46 to .81, Mdn. =.37. The effect of duration is generally consistent for all tests. Rho = .667. For significance at the .05 level with N = 8 a rho of .738 is required. The difference in rank is provided by marked changes in two subtests, manual expression and visual association. The two most stable subtests are grammatic closure (number 1 for both rankings) and auditory sequential which maintains its second place. Both of these subtests appear at the automatic level on the model given in figure 1.

Comparison of the stability of the subtests of the I.T.P.A. with those reported by Coleman in Table 2 for the WISC does not yield directly comparable data since neither the time interval, the factors measured, nor the sample are the same. Coleman's sample of 24 boys with learning disorders were tested at various intervals (M = 15 months). These data can provide only a rough guideline from which to judge the stability of the I.T.P.A. subtests over a 26 month period. For Coleman's data R = .29 to .68, Mdn. = .56; for the I.T.P.A. 26 month period R = .27 to .61, Mdn. =.37. From these data it is possible to conclude that the factors being measured by the I.T.P.A. are less stable than those measured by the WISC.

DISCUSSION

Correlation coefficients over time may be affected by five factors: (1) differences in one examiner over time or differences between examiners, (2) variability in sample, (3) the precision of the instrument, (4) situational fluctuations in examinee, (5) changes in the trait over time. It is difficult to determine the weight to be given to each of these

factors. Undoubtedly each of them entered into the scores just examined. In this research three advanced graduate students in school psychology administered the 1968 and 1969 tests with the same examiner administering the pre and post tests to each child. Two of those examiners were available for the 1971 testing. One may surmise that to some unknown extent examiner bias would operate in a uniform manner for all subjects under this situation.

In the standardization group this apparently was not the case. Although examiners were well trained and supervised, there is no mention in the manual of the same examiner administering pre and post measures. To some unknown extent one may surmise that examiner bias acted to raise the stability coefficients in this study.

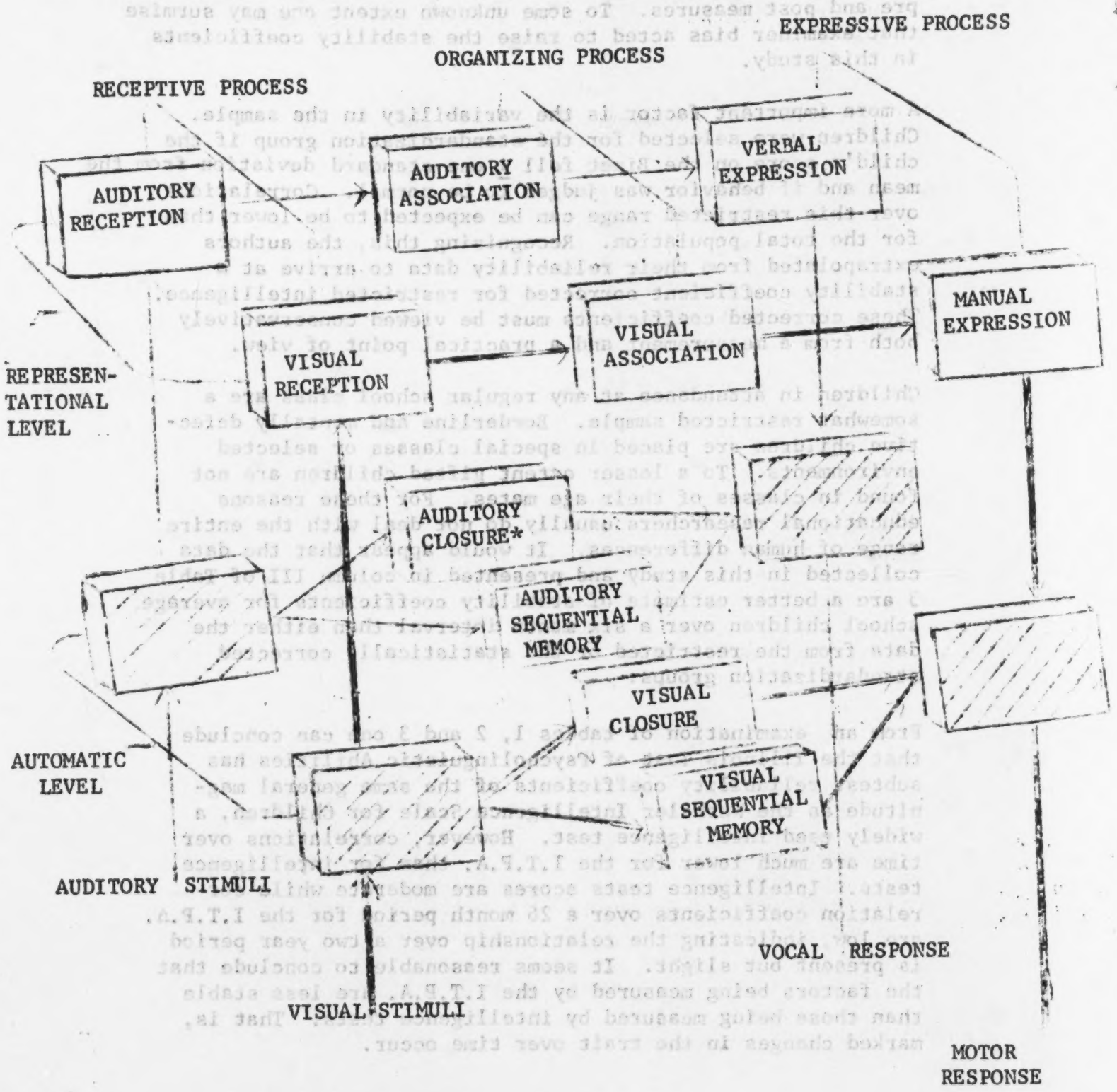
A more important factor is the variability in the sample. Children were selected for the standardization group if the child's score on the Binet fell $\pm$ one standard deviation from the mean and if behavior was judged to be normal. Correlations over this restricted range can be expected to be lower than for the total population. Recognizing this, the authors extrapolated from their reliability data to arrive at a stability coefficient corrected for restricted intelligence. These corrected coefficients must be viewed conservatively both from a measurement and a practical point of view.

Children in attendance at any regular school class are a somewhat restricted sample. Borderline and mentally defective children are placed in special classes or selected environments. To a lesser extent gifted children are not found in classes of their age mates. For these reasons educational researchers usually do not deal with the entire range of human differences. It would appear that the data collected in this study and presented in column III of Table 3 are a better estimate of stability coefficients for average school children over a six month interval than either the data from the restricted or the statistically corrected standardization groups.

From an examination of tables 1, 2 and 3 one can conclude that the Illinois Test of Psycholinguistic Abilities has subtest reliability coefficients of the same general magnitude as the Wechsler Intelligence Scale for Children, a widely used intelligence test. However, correlations over time are much lower for the I.T.P.A. than for intelligence tests. Intelligence tests scores are moderate while correlation coefficients over a 26 month period for the I.T.P.A. are low, indicating the relationship over a two year period is present but slight. It seems reasonable to conclude that the factors being measured by the I.T.P.A. are less stable than those being measured by intelligence tests. That is, marked changes in the trait over time occur.

FIGURE 1

Three-Dimensional Model of the I.T.P.A.



*Auditory Closure, Grammatic Closure, and Sound Blending subtests

TABLE 1

Correlations between intelligence test scores at age 7 and scores at selected ages (from Anderson, 1940, and Honzik, 1938.)

Honzik		Harvard Growth Studies		
correlations with age 7		correlations with age 7		
age	r	age	boys	girls
5	.73	8	.74	.65
6	.82	9	.70	.60
7	--	10	.73	.72
8	.83	11	.67	.67
9	.82	12	.64	.66

TABLE 2

Stability Coefficients for Wechsler Intelligence Scale for Children

Correlations after a mean test-retest interval of 15 months computed from scores of 24 boys with learning disorders (Coleman, 1963). These are compared with split-half reliability coefficients reported by Wechsler (1949) from scores of the standardization sample, age 7½.

	Coleman test-retest	Wechsler split-half	
Full scale	.77	.92	
Performance	.81	.86	without coding & mazes
Verbal	.62	.88	without digit span
Information	.52	.66	
Comprehension	.29	.59	
Arithmetic	.51	.63	
Similarities	.59	.66	
Vocabulary	.62	.77	
Digit Span	.57	.60	
Picture Completion	.38	.59	
Coding	.67	.60	
Picture Arrange ment	.36	.72	
Black Design	.56	.84	
Object Assembly	.68	.63	

These data indicate that long range educational planning on the basis of scores on the I.T.P.A. would be inappropriate.

TABLE 3

Stability Coefficients

	Standardization Data		This Study	
	6 year olds-5 mo. interval		5 year olds	
	Range		Interval	
	restricted	corrected	6 mo.	26 mo.
	I	II	III	IV
Auditory reception	.36	.63	.46	.28
Visual reception	.21	.56	.50	.34
Auditory Association	.70	.86	.72	.46
Auditory sequential	.82	.82	.74	.54
Visual association	.32	.45	.51	.49
Verbal expression	.46	.63	.55	.38
Gramatic closure	.49	.78	.81	.61
Manual expression	.49	.70	.57	.27
	Mdn. = .48	Mdn. = .67	Mdn. = .56	Mdn. = .42

Hypotheses 1b. Classification of subjects

ANALYSES

Although reliability coefficients give a general measure of change for groups, educators are primarily interested in classification of individual children. Subjects in this study were classified as auditory or visual subjects by two criteria. Changes over the three testing periods were noted and chi square was computed for the changes from 1968 to 1970.

Classification of children from their performance on the I.T.P.A. may be done by comparing the mean scaled score of the entire test with scaled scores on individual subtests. For this study children were classified as preferring the visual modality if the mean of visual reception and visual association subtests differed by one standard deviation from the mean of the auditory reception and auditory association tests. Of the thirty-nine children who were enrolled in the Eugene Public Schools for the two year period, six were classified as auditory learners in 1968 and 8 were classified as visual learners. By 1969 the ratio was the same but the categories were reversed: eight auditory learners and six visual learners. In 1971, eleven children were classified as auditory learners and two were classified as visual learners. It will be noted that the total number of children classified as discrepant does not change appreciably over the two years. A total of fourteen children were classified as preferring one modality in 1968 and 1969. In 1970 the total number remained at 13. By the more stringent classification the total number of children classified was reduced but the numbers remained the same for the three year period: 1968 - 6, 1969 - 6, 1970 - 5. However a direction of change from visual preference at age 5 to predominant auditory preference at age 7 is noted.

The authors of the manual for the I.T.P.A. suggest that a substantial discrepancy exists if an individual scaled score differs from the mean scaled score by $\pm$ 10. (page 95) An adaption of this classification system led to identification of those individuals whose mean of the visual subtests differed from the mean of the auditory tests by $\pm$ 10 scaled score points. These data are presented in Table 4. Using this more stringent criterion to classify the same group of children there are 2 auditory learners and 4 visual learners among the beginning kindergarten group in 1968, 4 auditory learners and 2 visual learners near the end of the kindergarten year in 1969, and five auditory learners and no visual learners when the subjects were mid-way through their second year in school.

The same direction of change is evident with each classification criterion.

TABLE 4

Numbers of children whose mean of tests for one modality was one standard deviation (± 6 scaled score points) above the mean of the tests in the other modality.

	Preferred Auditory	Preferred Visual
1968	6	8
1969	3	6
1971	11	2

Numbers of children whose mean of tests for one modality was ± 10 scaled score points above the mean of the tests in the other modality.

	Preferred Auditory	Preferred Visual
1968	2	4
1969	4	2
1971	5	0

DISCUSSION

Previous studies which investigated modality preference at different age levels were cross sectional rather than longitudinal. Conclusions differ from one study to the next and were drawn from comparison of performance on tasks constructed for that study by each investigator. As was pointed out in the review of research, tasks were seldom comparable across modalities or across age levels. The I.T.P.A. by contrast, has undergone extensive item analysis, factor analysis and a rigorous standardization procedure.

The results from the current study suggest that children may enter kindergarten with greater ability to receive and process visual information than auditory information. This visual preference changes to an auditory one, probably as the result of contact with the verbal world of the classroom.

Educators are frequently cautioned to interpret low correlations conservatively when making predictions about individual children. The formula for the coefficient of forcasting efficiency is $1 - \sqrt{1-r^2}$ If a correlation is .50 from the formula 1-.87 or .13. The tests forcasting efficiency is 13% (Garrett 1966). This study confirms the need for prudence. Using the stringent classification of discrepancy (± 10 scaled score points) no child in the sample of 39 maintained a modality preference over the two year period. It will be noted from Table 4 that there were 17 separate instances when a child reached this degree of discrepancy. Using the less stringent classification (± 6 scaled score points) two children maintained an auditory preference and one maintained a visual preference. From Table 4 it will be noted that there were 41 separate instances when a child reached this degree of discrepancy. One child had a visual mean 16.5 above her auditory mean in 1968. In 1969 her visual mean was 5.5 above her auditory which was too small to classify as discrepant. In 1971 her visual mean was 10.0 points below her auditory mean and thus would classify her as preferring the auditory modality.

Observed fluctuations in individual test performance and low correlation over time suggest the need for utmost caution in classifying children by their preferred modality.

Hypothesis 2. Matching modality preference to instruction using the I.T.P.A. to identify modality preference

ANALYSIS

To investigate the relationship between modality preference and performance under four instructional procedures four subtests of the Illinois Test of Psycholinguistic Abilities and memory tests being developed at the University of Oregon were administered to all the second grade children in five elementary schools in Eugene, Oregon. These same children participated in the four instructional procedures presented to classroom groups. Complete data were obtained for 166 children.

For the I.T.P.A. 8 subjects had a mean of the auditory reception and auditory association subtests which was 12 or more standard score points (2 standard deviations) above the mean of their visual reception and visual association scores. Nine subjects had a visual mean of 8 or more standard score points above their auditory mean. Each group constituted approximately 5 per cent of the entire sample of 166 subjects. These were the most discrepant subjects.

The discrepancy, or difference between their auditory and visual scores was greater than that of any of the other subjects. Scores on the auditory and visual recall tasks for these subjects are presented in Table 5. Reading horizontally it is evident that the subjects with a marked preference for visual subtests of the test do not perform better on the visual task. The mean of the visual subjects on the auditory recall task is 12.89. Mean on the visual recall task is 14.33. This difference does not approach statistical significance. Subjects with an auditory preference of 2 standard deviations or more on the test have almost identical scores on the two learning tasks: Auditory recall M = 17.88, visual recall M = 18.00.

A less stringent classification of modality preference derived from score on the I.T.P.A. yielded groups of approximately 10 per cent of the total sample. It was thought that this classification might yield information about the degree of discrepancy which could lead to matching of modality preference and instruction. However examination of the lower half of Table 5 indicates that the results do not differ from those achieved with the more discrepant group. Subjects with a visual mean one standard deviation above their auditory mean on the test did equally well on the auditory and visual recall tasks: Auditory recall M = 14.22, visual recall M = 13.83. In no case did the t-ratio approach significance. The null hypothesis was therefore supported for hypotheses 2 a and b. Children who show a preference for auditory subtests of the I.T.P.A. do not perform better on an auditorily presented recall task than they do on a visually presented task. Children who show a preference for visual subtests of the I.T.P.A. do not perform better on a visually presented recall task than they do on an auditorily presented recall task.

Hypotheses 2 c and d were concerned with the response of subjects after instructional procedures which were more complex in the sense that both visual and auditory components were integrated into a tracking procedure patterned after those recommended in manuals of basal reading programs.

The same subjects were compared on the word recognition and the recall tasks. Data from these comparisons are presented in Table 6. The null hypothesis was supported for hypotheses c and d. Children who had a preference for auditory subtests of the I.T.P.A. do not perform better on an auditorily presented word recognition task than they do on a visually presented task. Nor do children who show a preference for visual subtests perform better when instruction is matched to their preferred modality.

TABLE 5

Relationship between modality preference as measured by subtests of the Illinois Test of Psycholinguistic Abilities and performance on an auditory and a visual recall task

Most stringent classification of modality preference

	auditory recall	visual recall	
subjects with a visual preference of 8 or more standard score points (N=9)	$\bar{X}$ = 12.89 s = 3.59	$\bar{X}$ = 14.33 s = 4.42	t = .98 df = 8
subjects with an auditory preference of 12 or more standard score points (N=3)	$\bar{X}$ = 17.88 s = 3.68	$\bar{X}$ = 18.00 s = 2.20	t = -.41 df = 7
	t = 2.83*	t = -2.12	
	df = 15	df = 15	

Less stringent classification

	auditory recall	visual recall	
subjects with a visual preference of 6 or more standard score points (N=18)	$\bar{X}$ = 14.22 s = 4.04	$\bar{X}$ = 15.83 s = 4.12	t = -.71 df = 17
subjects with an auditory preference of 9.5 or more standard score points (N=19)	$\bar{X}$ = 17 31 s = 3 56	$\bar{X}$ = 16 47 s = 3 53	t = .87 df = 18
	t = 2.48*	t = -2.08*	
	df = 37	df = 35	

*significant at .05 level

TABLE 6

Relationship between modality preference as measured by the subtests of the Illinois test of Psycholinguistic Abilities and performance on an auditory and a visual word recognition task

Most stringent classification of modality preference

	auditory recognition	visual recognition	
subjects with a visual preference of 8 or more standard score points (N=9)	$\bar{X}$ = 9.00 s = 1.12	$\bar{X}$ = 8.67 s = 1.37	t = -.97 df = 8
subjects with an auditory preference of 12 or more standard score points (N=8)	$\bar{X}$ = 8.88 s = 1.36	$\bar{X}$ = 9.50 s = .76	t = -.83 df = 7
	t = -0.28 df = 15	t = -1.17 df = 15	

Less Stringent classification

	auditory recognition	visual recognition	
subjects with a visual preference of 6 or more standard score points (N=18)	$\bar{X}$ = 9.22 s = 1.09	$\bar{X}$ = 9.11 s = 1.45	t = -.36 df = 17
subjects with an auditory preference of 9.5 or more standard score points (N=19)	$\bar{X}$ = 8.89 s = 1.15	$\bar{X}$ = 9.11 s = 1.52	t = -.13 df = 18
	t = -0.921 df = 35	t = -0.01 df = 35	

DISCUSSION

Close scrutiny of these scores reveals that scores of the auditorially discrepant subjects are almost identical on the auditory and the visual tasks. The same conclusion can be drawn with respect to the visually discrepant subjects. Since each child served as his own control on the two dependent variables, problems of unidentified subject variables are minimized. Instructional procedures for both tasks were identical with regard to time used in presentation, selection of words and use of audio-visual equipment. Order of presentations were counterbalanced among classrooms. Scores for the two comparable tasks for the total sample (N=166) indicate that the tasks were equally difficult: auditory recall $\bar{X}$=15.67 s.d.=3.93 visual recall $\bar{X}$=15.69, s.d.=3.89. Auditory word recognition $\bar{X}$=9.14, s.d.=1.34 visual word recognition $\bar{X}$=9.05 s.d.=1.48.

Hypothesis 2. Matching modality preference to instruction using the memory tests to identify modality preference

ANALYSIS

Reliability data on the memory tests had been collected on samples of educationally handicapped children in the San Juan Unified School District, Carmichael, California. Reliability of the visual memory test was .56; auditory memory .68 after a two week interval. In the present investigation to ascertain the reliability of these measures with normal second grade children the tests were administered twice, with a two week time interval between administrations. Means, standard deviations and correlations for the two administrations are given in Table 7. A slight practice effect is evident. The mean of the second administration of the auditory memory test is 1.19 higher than the mean for the first administration. For the visual memory tests a .90 gain was achieved by the total group of 166 children. Reliability coefficients are .59 for the visual memory tests and .55 for auditory memory. These coefficients were interpreted to be adequate to warrant testing of the experimental hypotheses.

TABLE 7

Summary table of means and standard deviations for two administrations of the memory tests.

	N	Mean	Std Dev.	r
First admin. auditory memory	166	11.37	3.39	.55
Second admin. auditory memory	166	13.06	3 32	
First admin. visual memory	166	10.36	3 46	.59
Second admin. visual memory	166	11.26	3.38	

On the memory tests examination of the grand means for the test scores indicated that the auditory scores for the total sample (N=166) were 2.10 points higher than the visual scores. Visual mean was 11.07 auditory mean 13.17. Thus in considering differences between the two scores, obtained by subtracting the auditory from the visual -2.0 was considered to be the zero point. As with the I.T.P.A. data, two degrees of discrepancy were defined For the memory tests these were a preference of six or more points for each modality and a preference of four or more points. Data for these two classifications are in Table 8. Upon visual inspection it would appear that a disordinal interaction was found between modality preference as measured by the memory tests and instruction matched to that modality. Visual subjects do have a mean of 17.00 on the visual recall task and a lower score M=15.82, on auditory recall. The same is true of the auditory subjects. Auditory mean is 15.20 and visual mean 14.50 for these subjects. However when these data are submitted to statistical analysis the t ratio is nonsignificant. When the memory tests are used to classify subjects as preferring one modality over the other null hypotheses 2a and 2b are supported. Subjects who show a preference for the auditory memory tests do not show a corresponding facility with an auditorily presented recall task. This same conclusion can be drawn with regard to subjects labeled as visual learners.

Examination of hypotheses 2c and 2d was conducted with the same classification of subjects. These data are presented in Table 9. Again the null hypothesis is supported for both hypotheses and both classifications.

TABLE 8

Relationship between modality preference as measured by memory tests and performance on an auditory and a visual recall task

Most stringent classification of modality preference

	auditory recall	visual recall	
subjects with visual preference of 6 or more (N=11)	$\bar{X}$ = 15.82 s = 3.43	$\bar{X}$ = 17.00 s = 3.61	t = 1.17 df = 10
subjects with auditory preference of 6 or more (N=10)	$\bar{X}$ = 15.20 s = 4.83	$\bar{X}$ = 14.50 s = 4.77	t = 1.53 df = 9
	t = 0.34 df = 19	t = 1.36 df = 19	

Less stringent classification

subjects with visual preference of 4 or more (N=29)	$\bar{X}$ = 16.34 s = 3.15	$\bar{X}$ = 16.76 s = 3.30	t = 0.20 df = 28
subjects with auditory preference of 4 or more (N=22)	$\bar{X}$ = 14.73 s = 4.15	$\bar{X}$ = 14.09 s = 4.33	t = 0.53 df = 21
	t = -1.58 df = 49	t = 1.49 df = 49	

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TABLE 9

Relationship between modality preference as measured by memory tests, and performance on an auditory and a visual word recognition task.

Most stringent classification of modality preference

	auditory recognition	visual recognition	
subjects with visual preference of 6 or more (N=11)	$\bar{X}$ = 9.27 s = 1.19	$\bar{X}$ = 9.27 s = 1.42	t = .0 df = 10
subjects with auditory preference of 6 or more (N=10)	$\bar{X}$ = 8.30 s = 2.45	$\bar{X}$ = 8.20 s = 1.48	t = .0 df = 9
	t = -1.17 df = 19	t = 1.70 df = 19	

Less stringent classification

subjects with visual preference of 4 or more	$\bar{X}$= 9.37 s = .94 N = 29	$\bar{X}$ = 9.34 s = 1.01 N = 29	t = .23 df = 28
subjects with auditory preference of 4 or more	$\bar{X}$ = 8.82 s = 1.76 N = 22	$\bar{X}$ = 8.68 s = 1.52 N = 22	t = .56 df = 21
	t = 1.34 df = 49	t = 1.61 df = 49	

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DISCUSSION

The premise that certain children have a preferred modality which facilitates recall and recognition of words is certainly not supported by these data. Theoretical formulations which propose this idea are popular. However no published research which supports the modality concept in classroom practice could be located by this author. This research is congruent with other published reports cited in the review of the literature. Although simple as well as complex tasks were employed and subjects were classified on two separate tests none of the sixteen comparisons led to support for the proposition that instruction can be profitably matched to the modality preference of the subject.

AD HOC ANALYSIS AND DISCUSSION

Ad hoc analysis of some of the data was conducted. Correlation between auditory and visual memory tests and I.T.P.A. mean scores for each modality were computed. For the visual memory test and the mean of I.T.P.A. visual reception and visual association subtests the correlation was .19. The auditory memory scores and mean of the I.T.P.A. auditory subtests correlated .34 for the total sample (N=166).

These coefficients are low and raise the issue of construct validity of tests designed to measure modality strength. Correlations between tests purporting to measure the same modality are frequently low while those which are designed to measure discrete elements of a modality yield coefficients of approximately the same or higher magnitude. Thus correlations between the visual memory tests used in this study and the mean of visual reception and visual association subtests on the I.T.P.A. is .19. It would seem logical to describe both of these measures as visual tests, yet predicting from a correlation of .19 would be hazardous. Conversely, visual reception and visual association are designed to measure two separate facets of visual functioning. The correlation between them is .34 for the 5-7 to 6-1 age group. It is clear from these examples and from the word of Culbertson (1965) and Dykstra (1966) cited earlier that much remains to be done before educators can specify elements of modality functioning as discrete and separate entities.

It may be that conclusions previously drawn about modality preference are test-specific that is, more valid assumptions may have been possible if researchers had made statements about tests and tasks rather than about inferred psychological processes of subjects. In this research children who performed well on the auditory tests of the I.T.P.A. achieved higher scores on both the auditory and visual recall tasks than did the children who had a preference for the visual subtests. Thus although

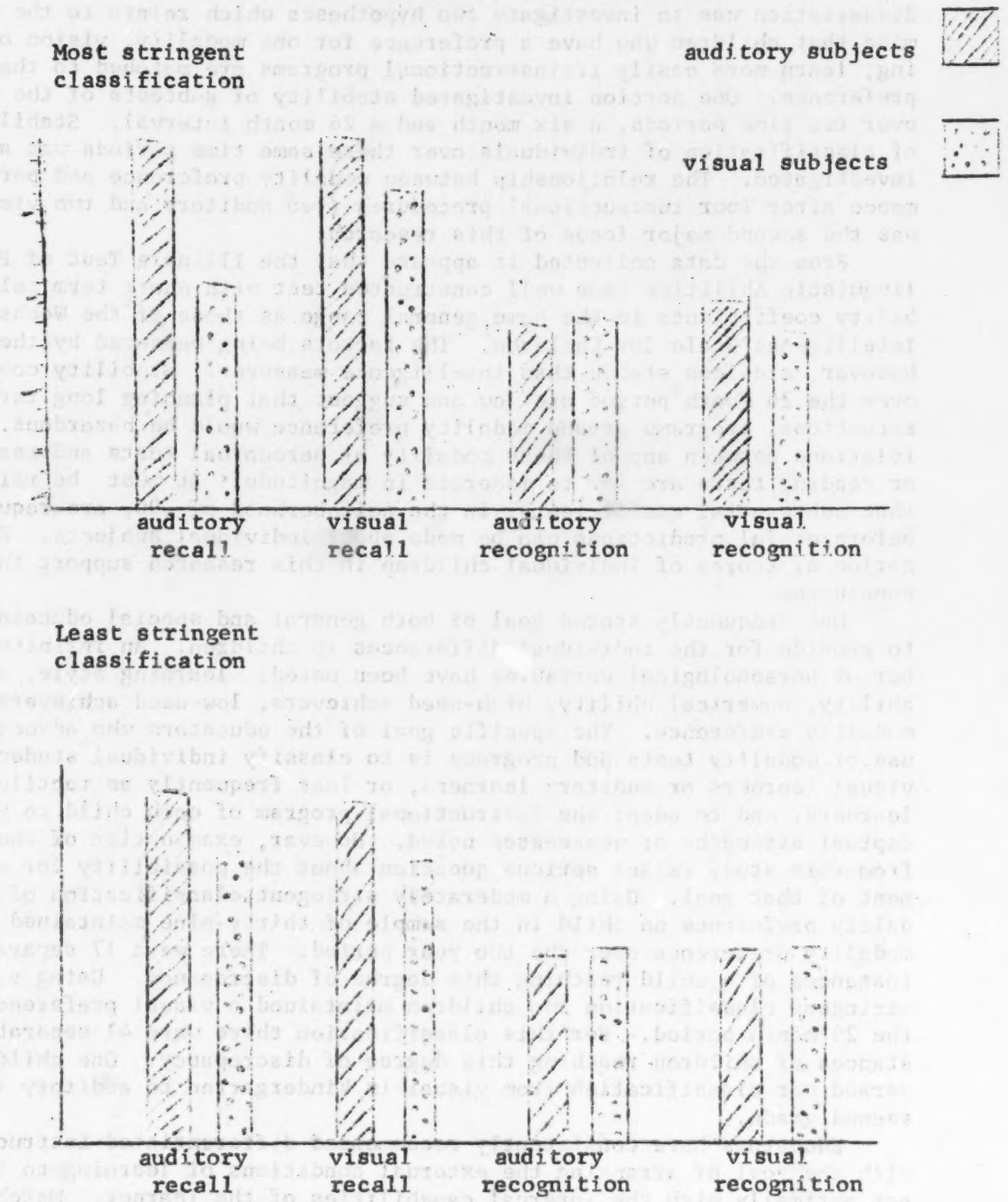
there was no disordinal interaction the auditory subjects did significantly ($p < .05$) better than the visual subjects on the simple auditory and visual recall tasks. This difference is portrayed graphically in Figure 2. These results are congruent with Bateman's review of the literature on the I.T.P.A. (1968). Auditory functioning as measured by the I.T.P.A. appears to be more important for recall of words than does visual functioning without regard for mode of presentation. It would be incorrect to conclude that a complex task such as reading should be taught in classrooms by any method labeled "auditory". Inspection of the bar-graphs for the word recognition task reveals no relationship to test performance. On the more complex word recognition task on which the instructional procedures had both visual and auditory elements and the subject circled the correct word from among four alternatives there was no interaction nor any statistical significance between performance of groups of auditory and visual subjects.

Bracht (1969) concluded that aptitude treatment interactions are more apt to occur when tasks are factorially simple as in the recall procedure, than when they are factorially complex as in the word recognition procedure. Aptitude treatment interactions also occur more frequently when measurement of treatment objectives is specific rather than general. The yes-no response of the recall task is thought to be simpler and more specific than the task of circling the correct word from among four options. Data from this study support Bracht's conclusion.

It may be that there are factorially simple skills prerequisite to performance in school subjects, which can be taught more effectively if instruction is matched to the modality preference of the child. If so, they should be identified. It appears unlikely that this avenue of exploration will yield major positive results. The 9 subjects were screened from a population of 166. It would hardly be practical to spend one hundred hours of staff testing time to identify a few children who <u>might</u> learn factorially simple tasks more readily if instruction is contrived to emphasize one modality.

FIGURE 2

Relationship between modality preference as measured by subtests of the Illinois Test of Psycholinguistic Abilities and performance on four tasks



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SUMMARY AND RECOMMENDATIONS

The burgeoning interest in modality functioning has spawned tests, instructional materials, and publications in the professional and popular press. This is a relatively new interest to educators. Major effort in this area has occurred during the last five years. The purpose of this dissertation was to investigate two hypotheses which relate to the premise that children who have a preference for one modality, vision or hearing, learn more easily if instructional programs are matched to that preference. One portion investigated stability of subtests of the I.T.P.A. over two time periods, a six month and a 26 month interval. Stability of classification of individuals over these same time periods was also investigated. The relationship between modality preference and performance after four instructional procedures (two auditory and two visual) was the second major focus of this research.

From the data collected it appears that the Illinois Test of Psycholinguistic Abilities is a well constructed test with short term reliability coefficients in the same general range as those of the Wechsler Intelligence Scale for Children. The factors being measured by the I.T.P.A. however, are less stable than intelligence measures. Stability coefficients over the 26 month period are low and suggest that planning long term instructional programs around modality preference would be hazardous. Correlations between any of these modality or perceptual tests and readiness or reading tests are low to moderate in magnitude. It must be reiterated that substantial coefficients, in the neighborhood of .90, are required before useful predictions can be made about individual subjects. Examination of scores of individual children in this research support this conclusion.

One frequently stated goal of both general and special educators is to provide for the individual differences in children. An infinite number of personological variables have been noted: learning style, spatial ability, numerical ability, high-need achievers, low-need achievers and modality preference. The specific goal of the educators who advocate use of modality tests and programs is to classify individual students as visual learners or auditory learners, or less frequently as tactile learners, and to adapt the instructional program of each child to perceptual strengths or weaknesses noted. However, examination of the data from this study raises serious question about the possibility for attainment of that goal. Using a moderately stringent classification of modality preference no child in the sample of thirty-nine maintained a modality preference over the two year period. There were 17 separate instances of a child reaching this degree of discrepancy. Using a less stringent classification two children maintained a visual preference over the 26 month period. For this classification there were 41 separate instances of children reaching this degree of discrepancy. One child reversed her classification from visual in kindergarten to auditory in second grade.

Educators have consistently recommended differentiated instruction, with the goal of arranging the external conditions of learning to interact optimally with the internal capabilities of the learner. Matching instructional procedures with modality preference is frequently recommended as one way to achieve this aptitude--treatment interaction. In

this study from a relatively large sample (N=166) the children who showed the greatest preference for auditory tests were selected. These 9 children had a mean score on their auditory tests two standard deviations or more above their own visual mean. Yet they scored equally well on auditory and visual recall tasks. The data were equally clear for the children showing a marked visual preference. There was no discernible relationship between a subject's modality preference as measured by the I.T.P.A. and his performance on recall or word recognition tasks.

Children were re-classified as auditory or visual subjects by their performances on auditory and visual memory tests being developed at the University of Oregon. With this grouping of subjects an indication of disordinal interaction was achieved, but statistical significance was not reached. That is, visual subjects did somewhat better on visual recall than they did on auditory recall. The converse was also true, producing the tendency toward disordinal interaction -- auditory subjects achieved higher scores on auditory recall than they did on visual recall. This interaction, however, did not reach statistical significance.

It was hypothesized that interaction was more likely on the factorially simple recall task using a simply yes-no measurement procedure than on the factorially complex word recognition task using a multiple choice measurement procedure. This hypothesis was partially supported by the direction of the results. No interaction was indicated with the more complex word recognition task.

Comparisons were also made between the performance of groups of visual and auditory subjects after each instructional procedure. That is, the performance of groups of auditory subjects was compared with that of groups of visual subjects on each of the four tasks. On these comparison the subjects who preferred the auditory subtests of the I.T.P.A. achieved significantly higher scores ($p < .05$) on both the auditory and visual recall tasks than did the visual subjects.

From these data one can conclude that factors measured by the auditory subtests of the I.T.P.A. are related to recall of words without regard to mode of instruction.

Recommendations

The author is reminded of Lee Cronbach's (1957) presidential address at the sixty-fifth annual convention of the American Psychological Association:

> "No man can be acquainted with all of psychology today.... The scene resembles that of a circus, but a circus grander and more bristling than any Barnum ever envisioned....We admire the agile paper readers swinging high above us in the theoretical blue, saved from disaster by only a few gossamer threads of fact, and we gasp as one symposiast thrusts his head bravely between another's sharp toothed jaws. This 18-ring display of energies and talents gives plentiful evidence that psychology is going places. But whither." p 671

The direction for the future for both psychology and education will depend upon how well each educator or psychologist examines the evidence, before recommending theory or practice. An analytical examination of evidence forms the basis for all science. Educators suggest teaching young children to differentiate fact from opinion. Educators also suggest teaching children to evaluate the adequacy of evidence before reaching a decision. Perhaps teacher education programs should be more heavily weighted with these objectives.

The negative results from studies which have attempted to demonstrate a relationship between modality preference and learning should not be viewed as representing futile effort. Useful information has come from these investigations . Directions for further research have been highlighted.

The importance of auditory functioning as measured by subtests of the I.T.P.A. has given additional impetus to evaluating the relationship between the entire speech-language process and achievement in reading. In Bateman"s review (1968) gifted children showed special strengths in auditory reception, auditory association, and auditory memory while groups of children who might be expected to have difficulty with reading had deficits in these areas. Hard of hearing and culturally disadvantaged negro children were shown to have remarkably similar profiles. In the present study subjects who had discrepancies in favor of the auditory subtests performed significantly better on both the auditory and visual recall tasks. The relationship between visual functioning and recall and recognition of words has been studied extensively, perhaps because there is an obvious connection between seeing and reading. It is also true that some aspects of visual functioning can be studied directly through eye-movement photography. The relationship between auditory functioning and reading is less obvious as well as less accessible to direct observation. Thus one may conclude that modality studies which highlight the crucial nature of language and speech may serve to shift research effort to an area of major importance.

It seems reasonable to assume that both auditory and visual perception are required for the acquisition of these school related skills. Jensen (1971) questions whether individuals do have a preferred modality and suggests that problems of research design have led to questionable conclusions. Jensen controlled for the design features he identified and after an experiment with 150 college students concluded that there was no evidence for individual differences as a function of sensory modality of input. Gibson (1969) talks of an active process of perception as compared to the "old sterile" concepts of visual and auditory perception. Intersensory facilitation, or the ability to shift between auditory and visual stimuli appears to be a fruitful avenue for research. The automatic level of the I.T.P.A. has been identified as being closely related to academic achievement. In this research the two subtests which remained most stable over the two year period were at the automatic level on the I.T.P.A.: grammatic closure and auditory sequential memory. Much research has been done on the other two levels from the communication models of Wepman or Osgood. Reflex behavior and abstract language (the other two levels) have been widely investigated since the beginning of scientific psychology. Research on modality functioning has focused attention on the intermediate

level of autonomisms.

Much research remains to be done in this area from theoretical laboratory experiments to classroom practice. Hilgard (1964) outlines a series of steps in research on learning which might form a model for this investigation. These include three pure research steps and three steps toward practical application. (1) Laboratory studies not directly relevant to practical questions may be carried on with laboratory animals. (2) Controlled laboratory studies on human learning may answer basic questions about the intersensory process. (3) Research which deals with school age subjects and material learned in school must be studied in the laboratory where control may be exercised by the researcher. (4) Once generalizations have been drawn from steps 1, 2, or 3, controlled classroom experiments are required. (5) Tryout in regular settings should follow. (6) Advocacy and adoption by textbook companies and school districts should be the last step in this orderly procession of research. It would be possible to sketch a series of studies progressing from pure research to practical application in each of the three areas emphasized by previous modality research. Indeed language development, cross-modal functioning and task delineation are three active current research interests.

The desire for magical cures is almost an endemic disease of educators, and may be typical of our entire culture. Gasoline additives are said to make an ancient auto run smoothly. A certain brand of tooth paste insures a smiling countenance and friends to smile upon, if one believes implications behind some advertising. In much the same view new educational programs are sold. However, educators and psychologists have a scientific and ethical responsibility to society that is heavier than that borne by manufacturing enterprises. Educators must take the laborious route of empirical validation through the six steps outlined by Hilgard. Fanciful leaps from theoretical formulation to published programs and tests can only serve to impede genuine progress.

Since so much aptitude-treatment interaction research has not led to valuable findings it seems wise to shift at least a segment of research effort to the learning processes used in relationship to the educational task. How are the sound-symbol bonds formed between speech sound and letter? Gibson's(1969) interpretations of work done toward identifying discriminants, and invariants in special sounds and letters provide useful directions for study. How does the clustering of sound-symbol units occur? For a hundred years, since the first eye-fixation studies, we have known that readers see a chunk of letters at one time. Very little is known about how this clustering is learned.

Some progress has been made in identifying specific task units which relate to performance in reading. Chall's (1967) synthesis of research confirmed the value of direct teaching of the sound-symbol code. Waugh (1970) found that teachers were able to use reports which identified educational deficits in specific tasks. Reports which concentrated on personological variables of the subjects were considered to be less useful. Some combinations of investigation of learning process and task analysis seem to offer the most profitable avenue for further research.

Words Selected from Teachers Word Book of 30,000 by Stratified Sampling, Every Twelfth Multisyllabic Word*

Presented 3 times in visual recall task	Added to words for visual recall	Presented 3 times in auditory recall task
1. attitude	1. anger	1. area
2. coffee	2. chamber	2 circumstances
3. detail	3. credit	3. darkness
4. fashion	4. evidence	4. expression
5. inside	5. hospital	5. importance
6. midnight	6. manufacture	6 merchant
7 poem	7. passion	7. pity
8. reader	8 property	8. quality
9. somewhat	9 series	9. shadow
10. vessel	10. treasure	10. university

Added to words for auditory recall	Stimulus words for auditory word recognition	Stimulus words for visual word recognition
1. activity	1. balance	1. border
2. breakfast	2. committee	2. conduct
3. contract	3. disease	3. dozen
4. effect	4. friendship	4. glory
5. handle	5. leather	5. level
6. limit	6. murmur	6 operation
7. ordinary	7. possession	7. presence
8. process	8. reveal	8 sacrifice
9. salary	9. substance	9. telephone
10. territory	10. worker	10. yesterday

* These words were used in the recall and word recognition tasks noted

Score Sheet for Visual Word Recognition Task

Visual Recognition

NAME _____

Trial	yes	no	come	here
1	bought	anger	chamber	border
2	merchant	confidence	conduct	evidence
3	hospital	dozen	passion	doctor
4	glow	series	glory	palace
5	level	herald	liberty	machinery
6	oppose	professor	section	operation
7	property	presence	preserve	series
8	sacrifice	treasure	safety	darkness
9	operation	temple	telephone	shadow
10	yesterday	irrigate	twenty	yearly

Score Sheet for Auditory Word Recognition Task

Auditory Recognition

NAME _____

Trial	yes	no	come	here
1	balance	irradiate	department	basket
2	segment	committee	locate	community
3	distant	capital	plate	disease
4	schedule	ticket	friendship	freedom
5	leather	concern	lesson	expense
6	murder	nobody	unite	murmur
7	possibly	possession	fifteen	appointee
8	revolution	passable	reveal	inquire
9	substance	succeed	medical	learner
10	magazine	worst	worker	choice

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Score Sheet for Recall Tasks

Auditory Recall*

NAME_____

Trial	Yes	no
1	yes	no
2	yes	no
3	yes	no
4	yes	no
5	yes	no
6	yes	no
7	yes	no
8	yes	no
9	yes	no
10	yes	no
11	yes	no
12	yes	no
13	yes	no
14	yes	no
15	yes	no
16	yes	no
17	yes	no
18	yes	no
19	yes	no
20	yes	no

*Visual recall was identical except for heading.

Score_____

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Words Used for Memory Tests*

_____kitten	_____boy
_____cow	_____tree
_____milk	_____room
_____egg	_____fire
_____dress	_____man
_____pig	_____home
_____rabbit	_____week
_____king	_____bed
_____cat	_____pet
_____children	_____fun
_____store	_____rat
_____toy	_____hat
_____men	_____name
_____food	

*These words were typed with a primary typewriter on white index cards cut to 3½ x 2 inches.

Score Sheet for Memory Tests

Subject's Name_____ Date_____

Test of_____Visual Memory

_____Auditory Memory

Number of Words	Correct (o) or Incorrect(x) on Trial:	
2	1_____	2_____
3	1_____	2_____
4	1_____	2_____
5	1_____	2_____
6	1_____	2_____
7	1_____	2_____
8	1_____	2_____
9	1_____	2_____
10	1_____	2_____

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